

JAPANESE

JP,07-053825,A)

Drawing selection **Drawing 1**

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS OPERATION EXAMPLE DESCRIPTION OF DRAWINGS DRAWINGS

[Translation done.]

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## DETAILED DESCRIPTION

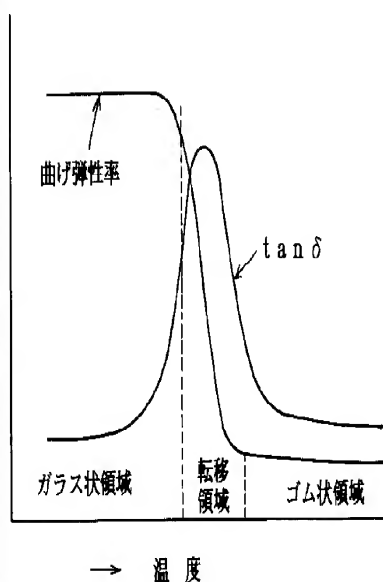
[Detailed Description of the Invention]

[0001]

[Industrial Application]While this invention controls generating of vibration or prevents the propagation in the field of an industrial machine, electronic equipment, home electronics, audio equipment, a car, etc.,. It is related with members for audio equipment, such as a leg of the high-damping material used in order to also attenuate generated vibration quickly, slide members, such as a bearing, a gear cam, etc. produced now, and a speaker diaphragm and a speaker cabinet, and audio equipment, and a CD tray.

[0002]

[Description of the Prior Art]The advancement of the damping art of suppressing noise and vibration is called for from the social needs of pursuing recent years more comfortable environment. Especially vibration and noise that are generated from electronic equipment, home products, etc. are social-problem-ized, and the control has become pressing need.



[Translation done.]

[0003]In order to solve problems, such as such noise, vibration, etc., it is required for the gear and cam which are the sources of release of vibration or noise, and the exterior member which is the propagation path to use the high-damping material which attenuates vibration quickly. On the other hand, a clearer sound is searched for in the field of audio equipment. In order to generate a clear sound, it is required for a speaker diaphragm to vibrate as a signal and to attenuate a pre-vibration (reverberation) quickly. Also in order to intercept an external vibration and reflected vibration and to leave only a required vibration, the use of a high-damping material of a speaker diaphragm is indispensable to other sound members called the leg of audio equipment, the cabinet of a speaker, and CD tray from the first.

[0004]There is an ethylene-vinylacetate copolymer (EVA) as one of the outstanding materials used for such a member. This EVA is already used as a high-damping material in (1) JP,57-34949, A, (2) JP,61-10447,A, (3) JP,2-302455,A, and (4) JP,3-290457,A.

[0005]  
[Problem(s) to be Solved by the Invention]EVA currently indicated by each gazette of above-mentioned (1) - (3), The ratio of vinyl acetate (PVAc) is 10-45-mol %, since the glass transition temperature (T<sub>g</sub>) becomes less than -10 \*\*, damping nature becomes the highest below 0 \*\*, and such materials show only low damping nature at the temperature near [ which is actually used ] a room temperature.

[0006]On the other hand, as for the thing of the indication to JP,3-290457,A of (4), damping nature with vinyl acetate high near a room temperature with more than 60 mol % is obtained. However, generally, with a polymer material, since a relation between damping nature and rigidity as shown in drawing 1 is, required rigidity when using a high material of damping nature as parts and a member is not obtained.

[0007]So, in JP,3-290457,A, in order to raise rigidity, the more than twice as many scale-like bulking agent as EVA is added. However, extensive addition of such an inorganic bulking agent will spoil character other than damping nature greatly. For example, when it uses as slide members, such as a gear and a cam, a mating member is worn out for these inorganic bulking agents, and own abrasion resistance does not become useful bad, either. If an inorganic bulking agent with such large specific gravity is added in large quantities when it uses for a sound member like a speaker diaphragm, the specific gravity of a high-damping material will also become large, and the acoustic velocity which is the essential property of a relation to the diaphragm shown in a lower type will also become small.

[0008]

[Equation 1]

音速と剛性（弾性率）と比重の関係

$$\text{音速} = \sqrt{\frac{\text{弾性率}}{\text{比重}}}$$

[0009]That is, the high-damping material which improved rigidity only by addition of the bulking agent becomes what was properly missing as a slide member and an object for sound members.

[0010]Then, this invention shows high damping nature at a room temperature, and it has high rigidity, and its important acoustic velocity is also still larger in a speaker diaphragm, and it makes it the technical problem to provide the high-damping material which becomes what excelled [ addition / of the oil ] also in the sliding characteristic, the moving part using this, and the member for audio equipment.

[0011]

[Means for Solving the Problem]A high-damping material of this invention which solves the above-mentioned problem uses as the substance A a vinyl acetate ethylenic copolymer (EVA) whose quantity of vinyl acetate is more than 70 mol %, The substance A blends this substance A and thermoplastics at a rate of ten to 50 weight section more preferably ten to 100 weight section to thermoplastics 100 weight section.

[0012]The substance A is for giving damping nature, and in order to obtain high damping nature near a room temperature, it uses EVA which carried out a mole ratio of vinyl acetate more than 70 mol % in this invention.

[0013]As thermoplastics, polyethylene, polypropylene (PP), Polyolefines, such as the Poly 4-methylpentene- 1 (PMP), or polyvinyl chloride, Vinylid halide resin, such as a polyvinylidene chloride, or methyl methacrylate, Acrylic resins, such as methyl acrylate, ethyl acrylate, and butyl acrylate, Or polyvinyl alcohol or acrylic nitril Butadiene Styrene (ABS plastics), An acrylic nitril styrene copolymer (AS resin), an acrylic \*\*\*\*\*. \*\*\*\*\*. acrylic ester copolymer (ASA resin), A copolymer which uses acrylic nitril and styrene, such as an acrylic nitril ethylene-styrene copolymer (AES resin), as an indispensable ingredient, Or combination copolymer, a blend article, etc. of single resin or some arbitrarily selected resin which are chosen from things which made one of resin, such as polystyrene, polyacetal (POM), polycarbonate, polyester, polyamide, or this, contain an oil are used.

[0014]If oleo resin which added an oil is especially adopted as polybutylene terephthalate (PBT), POM, or polyamide, it becomes a high-damping material with sliding nature which had high damping nature and high rigidity and was excellent, and can use suitably for slide members, such as a bearing and a gear. A thing using a copolymer which uses styrene and butadiene as an essential ingredient can be used for housing of OA equipment or audio equipment.

[0015]On the other hand, if polypropylene and with a specific gravity of 1.0 or less of Poly 4-methylpentene-1 grade resin are adopted, If it becomes a high-damping material which has low specific gravity, i.e., the characteristic of high acoustic velocity, by high damping nature and high rigidity and a scale-like bulking agent is further added into such materials, Although specific gravity becomes large, in order to become a bigger material as a result than that of acoustic velocity since the rigid rise rate is larger than a rise rate of specific gravity and to also raise damping nature by leaps and bounds, it is suitable for members for audio equipment, such as a leg of a speaker diaphragm, a speaker cabinet, and audio equipment, and a CD tray.

[0016]

[Function]Rigidity falls near glass transition point Tg loss coefficient  $\tan \delta$  the high-damping material which consists of polymer compositions generally indicates damping nature to be takes the maximum. So, in this invention, although near the room temperature showed high  $\tan \delta$ , in the large temperature region near a room temperature, high damping nature and mechanical properties were demonstrated by blending the rigid low above-mentioned substance A and the thermoplastics which has high rigidity at a specific rate.

[0017]In the case of a polymer composition, as shown in drawing 1, above-mentioned  $\tan \delta$  becomes the maximum near the glass transition temperature (Tg) of the constituent. On the other hand, in the case of a vinyl acetate ethylenic copolymer, it changes with the content ratios of the above-mentioned Tg vinyl acetate. Vinyl acetate is contained in EVA shown in the gazette of three affairs besides previously quoted JP,57-34949,A only 10-45-mol%. The peak of damping nature will be 0 \*\* or less for the mole ratio of this vinyl acetate to be less than 70%, and high damping nature is not obtained in a room temperature region. The mole ratio of Tg of 70% of copolymer in the inside of the copolymer of vinyl acetate is abbreviation-10 \*\*, and the peak of  $\tan \delta$  comes near 0 \*\*. If the degree of polymerization of vinyl acetate is raised more than it, this Tg will also go up and high damping nature will be obtained in 0-40 \*\*. This invention adopted the substance A which carried out the amount of vinyl acetate more than 70 mol %, and raised Tg to near a room temperature paying attention to this point.

[0018]However, a mechanical property falls with the rise of damping nature in this case. For this reason, although JP,3-290457,A has tried the rigidity improvement in how to add EVA for a scale-like bulking agent more than twice, it cannot raise rigidity, without the sliding nature and acoustic velocity which are the practical required characteristic falling remarkably, and spoiling sliding nature, specific gravity, etc. in such a method. Rigidity was able to be improved in this invention, without spoiling sliding nature and specific gravity for the above-mentioned substance A a 10 - 100 weight-section blend or by alloy-izing to suitable thermoplastics. Here, since the improved effect of damping nature was hardly expected but the quantity of the substance A, on the other hand, increased that they are 100 or more weight sections more than the quantity of thermoplastics if the addition of the substance A is less than ten weight sections, the addition of the substance A was limited to ten to 100 weight section in order for rigidity to fall substantially.

[0019]In this invention, high sliding nature, high damping nature, and high rigidity were realized by blending high sliding nature thermoplastics, such as PBT and POM, with the substance A. Although the case used for slide members, such as a bearing and a gear, may require still higher sliding nature, In that case, damping performances excellent in slide members, such as a bearing, a gear, etc. which could realize much more sliding nature rise to the above-mentioned sliding nature high-damping material, and was not conventionally made to it by adding an oil, were added, it vibrated, and it became possible to reduce noise. High damping nature, and low specific gravity and high rigidity, i.e., the high-damping material of high acoustic velocity, were realized by blending low PP and PMP of specific gravity with the substance A. In this invention, a scale-like bulking agent into the material of such high damping nature quantity acoustic velocity by

carrying out 10-150 weight-section addition to the thermoplastics 100, Since the rise rate of the elastic modulus became larger from the rise rate of specific gravity, acoustic velocity also improved simultaneously [ with damping nature ] as a result, and it became possible to provide the suitable high-damping material for an audio equipment member.

[0020]

[Example] Each of the invention material 1 and the comparison material 1 and 2 which are shown in Table 1, the invention material 2-18 shown in Table 2, and the comparison material 2-6 was fabricated with the injection molding machine, and the specimen (13 mm in width, 126 mm in length, and 3 mm in thickness) was created.

[0021] The invention material 1 in Table 1 is the blended resin which made the amount% of substance A of vinyl acetate of 80 mol the weight ratio of the polyamide 6 and 1:2, and was obtained by carrying out melt kneading with the biaxial extruder.

[0022] The comparison material 1 is amount% of EVA of vinyl acetate of 25 mol, and the comparison material 2 is the amount% of substance A of vinyl acetate of 80 mol.

[0023] On the other hand, the invention material 2-18 and the comparison material 2-6 of Table 2 are the mixture which added the thermoplastics shown in Table 2 at the amount% of substance A of vinyl acetate of 80 mol, and a bulking agent at a rate shown in the table, and was blended with the roll and the biaxial extruder.

[0024] The details of the substance A in Table 1 adopted in this example and Table 2, the resin B-N, and bulking agent O-R were shown in Table 3 together with the manufacture name and the trade name.

[0025]

[Table 1]

	発明材 1	比較材 1	比較材 2
樹脂 B (重量部)	100	0	0
樹脂 C (重量部)	0	100	0
樹脂 A (重量部)	50	0	100
t a n δ	0.18	0.06	0.42
曲げ弾性率 E (kg/cm <sup>2</sup> )	6400	300	100 以下

[0026]  
[Table 2]

※ 1

	発明材 2	発明材 3	発明材 4	発明材 5	発明材 6	発明材 7
熱可塑性樹脂	D	E	E	F	G	H
添加量 (重量部)	100	100	100	100	100	100
鱗片状充填剤	—	—	—	—	—	—
添加量 (重量部)	—	—	—	—	—	—
物質 A ( % )	15	100	15	50	50	50
t a n δ	0.09	0.20	0.12	0.11	0.13	0.21
曲げ弾性率 E (kg/cm <sup>2</sup> )	19500	8000	17000	18000	17700	8200

※ 1 ※ 2

発明材 8	発明材 9	発明材 10	発明材 11	発明材 12	発明材 13	発明材 14	発明材 15
I	J	K	K	K	L	L	I
100	100	70	70	60	60	60	60

100	100	70	70	60	60	60	60
—	—	O	O	P	O	O	Q
—	—	30	30	40	40	40	40
50	50	15	100	30	15	50	30
0.20	0.23	0.11	0.25	0.11	0.07	0.27	0.19
10000	5800	34000	10000	45000	56000	21000	26000

※ 2

発明材16	発明材17	発明材18	比較材 3	比較材 4	比較材 5	比較材 6
G	M	N	—	S	T	U
100	(74%配合樹脂)	100	—	M74% 5557	デルリン 500T	スチロ PH810
O, R		—	O			
40	合計 100	—	200			
10	30	30	100			
0.07	0.15	0.07	0.18	0.11	0.03	0.03
55000	23000	62000	1700	2100	22500	21000

[0027]

[Table 3]

物質 A	酢酸ビニル-エチレン共重合体 (大日本インキ製 エバスレン250)
樹脂 B	ポリプロピレン (三井石油化学製 ハイボールB240)
樹脂 C	エチレン-酢酸ビニル共重合体 (住友化学製 エバラートK2010)
樹脂 D	ポリエステル (住友電工製 含油プラスチックPBT-L)
樹脂 E	ポリアセタール (住友電工製 含油プラスチックA-L)
樹脂 F	ABS樹脂 (三菱レイヨン製 ダイヤベットABS3001)
樹脂 G	アクリル樹脂 (三菱レイヨン製 アクリベットMF)

樹脂 G	アクリル樹脂	(三菱レイヨン製 アクリベットMF)
樹脂 H	ポリアミド	(東レ製 リルサンAESN O, TL)
樹脂 I	ポリエステル	(三菱レイヨン製 タフベットPBT N1000)
樹脂 J	ポリアセタール	(住友電工製 含油プラスチックA-HH)
樹脂 K	ポリプロピレン	(三井石油化学製 ハイボールJ900)
樹脂 L	ポリアミド	(東レ製 アミランCM-1021)
樹脂 M	ポリプロピレン/マイカ	(クラレ製 MRP 230-LL2)
樹脂 N	液晶ポリエステル	(ユニチカ製 ロッドランLC3000)
充填剤 O	マイカ	(クラレ製 スズライトマイカ 325-K1)
充填剤 P	マイカ	(クラレ製 スズライトマイカ 150-S)
充填剤 Q	マイカ	(クラレ製 スズライトマイカ 200-K1)
充填剤 R	グラファイト	(中越黒鉛製 CX 600)
S	熱可塑性エラストマー	(東レ・デュボン社製 ハイトレル5557)
T	ポリアセタール	(デュボンジャパン社製 デルリン 500T)
U	ポリスチレン	(住友化学製 スミブライトPH810)

[0028]<> The above-mentioned specimen made from the material of the example of quality assessment-experiment 1-table 1 was set to the tester as shown in drawing 2, the electromagnetism excitation of the lower part of the specimen was carried out within the thermostat with a temperature of 20 \*\*, the transfer function of vibration was measured in the specimen upper part, and it asked for loss coefficient  $\tan\delta$  by the half-the-price width method from the secondary resonance point. The excitation frequency in this case is 500 Hz. According to ASTM D790, the rate E of bending flexibility under the temperature of 20 \*\* was investigated about each sample. The result is shown according to Table 1.

[0029] $\tan\delta$  of the substance A (comparison material 2) whose amount of vinyl acetate is 80-mol % is large also 7 times compared with 25-mol% of EVA (comparison material 1) so that this test result may show. However, the rate E of bending flexibility is falling and, the way things



stand, cannot be used as a high-damping material when it is too soft and rigidity is required. On the other hand, although damping nature ( $\delta$ ) is falling to an abbreviation half compared with the comparison material 2 of the substance A, the invention material 1 which blended the substance A with the polyamide 6 is large by leaps and bounds (60 or more times), and can fully use rigidity (the rate E of bending flexibility) as a high-damping material. As for this invention material 1, damping nature of 3 times and rigidity is improving by about 30 times also comparison with the comparison material 1.

It was the outstanding high-damping material.

[0030]- Also about the specimen made from the material of the example of experiment 2-table 2,  $\delta$  in the rate E of bending flexibility in 20 \*\*, and 20 \*\* and 500-Hz excitation was measured by the same method as the example 1 of an experiment. The result is written together to Table 2.

[0031] Compared with the comparison material 3 which added mica to the substance A, rigidity and damping nature are large and the invention material 3, 7, 8, 9, 11, 14, and 15 has become a high-damping material superior to the high-damping material which added only the bulking agent to EVA and attained high rigidity-ization. Although  $\delta$  is somewhat low compared with the comparison material 3, other invention material is also increasing, so that it is not compared, and rigidity's is the optimal as a high-damping material of which especially high rigidity is required. Even if it compares these high-damping materials with other high-damping materials (comparison material 4-6) marketed, they are in damping nature and rigidity as \*\*, and they are the very outstanding high-damping materials.

[0032]- When using an example of experiment 3-high-damping material for a bearing, a gear cam, etc., from the first, the sliding nature which material has is large to the performance of a member, and a life, and damping performances and mechanical properties influence. Then, the sliding characteristic of the material resin made as an experiment using the thrust wear test machine was investigated. This examination is a high-damping material of the invention material 2 and 4 of Table 2, and the comparison material 3, 4, and 5, While having made the disc-like specimen (the outer diameter of 50 mm, 11 mm in inside diameter, and 2.5 mm in thickness), forcing metal cylinders on this by the pressure of 5 kg, making it rotate for 2 minutes with the revolving speed of 500 rpm and calculating the dynamic friction coefficient of each sample, the wear depth of the wear part was measured. The result is shown in Table 4.

[0033]

[Table 4]

	発明材 2	発明材 4	比較材 3	比較材 4	比較材 5
動摩擦係数	0.16	0.13	0.32	0.23	0.15
摩耗深さ (mm)	0.01	0.01	1.00以上	0.02	0.01

[0034]also in rigidity, sliding nature, and wear-resistant any, the high-damping material of this invention is markedly looked like [ EVA like the comparison material 3 ], excels the high-damping material which added the scale-like bulking agent in it, and can make the slide member of high performance and high damping nature so that the above experiment may show.

[0035]- The characteristics required for the high-damping material for example of experiment 4-sound members are damping nature and acoustic velocity. Acoustic velocity is searched for from an elastic modulus and specific gravity, as shown in a formula shown above. The acoustic velocity of the invention material 10, 12, 13, 16, and 18 for which it asked using the formula, and the comparison material 3 is shown in Table 5.

[0036]

[Table 5]

	発明材10	発明材12	発明材13	発明材16	発明材18	比較材 3
音速 (m/sec)	1720	1900	2140	2030	2130	300

[0037]In order to use a high-damping material as a speaker diaphragm, not less than 1500 m/sec acoustic velocity is required. The invention material 10, 12, 13, 16, and 18 in Table 2 has all fully satisfied this characteristic, and tandelta also becomes those or more with 0.07, and the outstanding sound member.

[0038]

[Effect of the Invention]Since the high-damping material of this invention demonstrates rigidity and high damping nature outstanding near the room temperature and high sliding nature, and high acoustic velocity as explained above, The parts with which becoming vibrating at the time of use or a vibration transmission way is not avoided, If a member and vibration are adopted as exterior members, such as slide members, such as the parts and member which must be absorbed immediately, for example, the support member of motors, a bearing, a gear cam, or housing, and an engine cover, a big effect will be done so to vibration, deterrence of noise, and reduction. If it is adopted as members for audio equipment, such as a leg of a speaker diaphragm, a speaker cabinet, and audio equipment, and a CD tray, a big effect will be done so also to the improvement in other tone quality of vibration and prevention of noise.

[Translation done.]